PLANETARY MAGNETISM: OBSERVATIONS AND CONVECTION.

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The observed/estimated own magnetic fields of the Earth, planets, moons and large asteroids are mainly generated by convection in their deep interior nowadays, in the past and in the future. Since 1840 Gauss founded the service of full-fledged observational observations, while regular observations of the direction of geomagnetic fields began to be documented in ship logs more than a few centuries ago. Archeos (from hundreds to tens thousand years) and paleo (up to 4 billion years) magnetic evidence of magnetic evolution are directly accessible to the Earth and the Moon, and indirectly through meteorites for Mars, asteroids and presumably other objects.

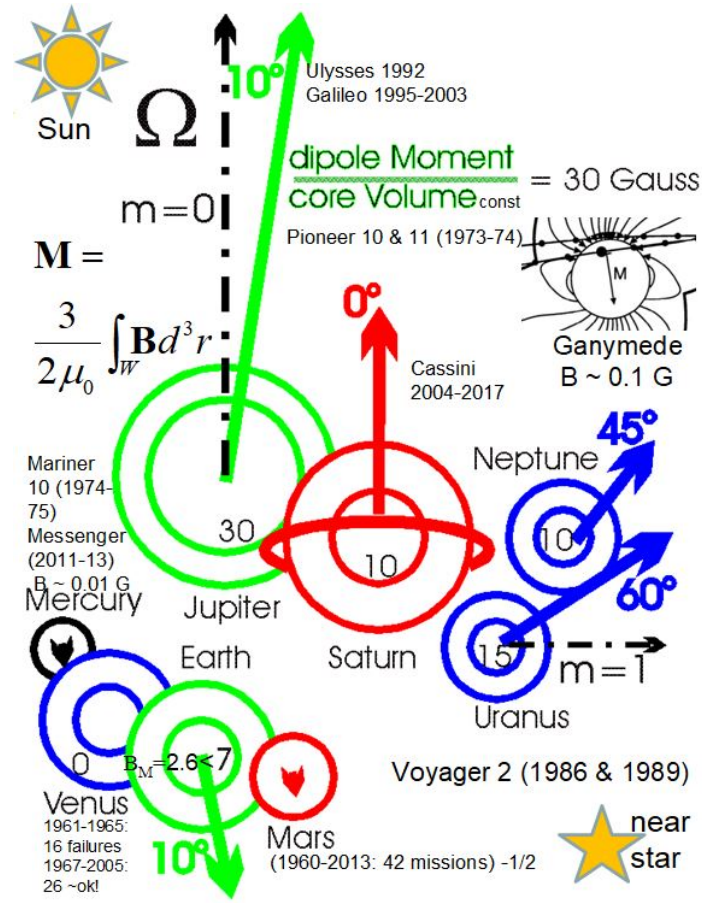

Figure. Satellite missions and internal magnetic fields are schematically shown.

The most reliable and detailed magnetic data became available with the onset of the satellite era (see Figure), which is too short compared to tens/hundreds of thousands of years of typical magnetic diffusion in the conducting interiors of planets and moons. Nevertheless, in this work, based on satellite observations, the vectors of the arithmetic mean magnetic field and convective properties for the deep interiors of all known magneto-active/non-magnetic (many years ago/after as well) all Solar system planets, Ganymede and Moon have been reliably determined. While the observable/estimated magnetic variations allow estimating the magneto-convective scales and heat/composition energy power of hydro-magnetic dynamos in the interiors of the Jupiter, Saturn, Earth and Mercury.

Magneto-convection similar to the planetary for 23 years is successfully modeled by hundreds of physically self-consistent numerical models that are not sufficiently successful for the concrete application to the Earth, planets and moons because of the huge remoteness of key parameters of these models from real ones. In this work, the scaling laws are analytically and numerically derived, which directly rely on these key extreme parameters of the planets. At the same time, it is possible to reconcile both numerical and real planetary models.

Thus, in this work I investigate/estimate relations between the observed/absent own magnetic field and the internal magneto-convection/convection properties in the Earth, all the Solar system planets, Moon and Ganymede nowadays, in the past and in the future.